The multi-platform operational validation of the Western Mediterranean SOCIB forecasting system

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1. Introduction and objectives

The development of science-based ocean forecasting systems at global, regional, and local scales can support a better management of the marine environment.

➢ The Balearic Islands Coastal Observing and Forecasting System (SOCIB) has developed an **operational ocean forecasting system in the Western Mediterranean Sea (WMOP)**. The high-resolution WMOP system aims at reproducing both the basin-scale ocean circulation and the mesoscale variability which is known to play a crucial role due to its strong interaction with the large scale circulation in this region.

➢ An **operational validation system** has been developed to systematically assess the model outputs at daily, monthly and seasonal time scales to evaluate the general realism of the daily ocean forecasts.

➢ Additionally, different **oceanic indicators** are computed both at the basin-scale and in several sub-regions.

The daily forecasts, validation diagnostics and indicators from the operational model over the last months are available at **www.socib.es**.

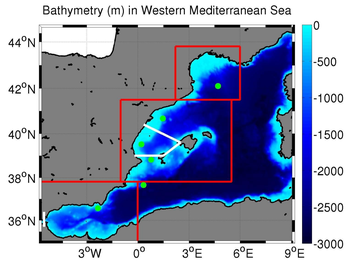


Fig. 1: Model configuration

2. The Western Mediterranean OPerational (WMOP) system

High-resolution regional configuration of the ROMS ocean model[1] extending from Gibraltar strait to Corsica/Sardinia [6°W-9°E; 35°N-44.5°N] (Fig. 1)

- Bottom topography from 30'' database[2]
- Spatial resolution: ~1.5-2km
- Vertical resolution: 32 sigma levels
- Boundary conditions: MFS[3]
- Atmospheric forcing: AEMET Hirlam (3h, 5-6km)
- Ebro and Rhone climatological runoff
- Model is restarted weekly using a 3 weeks spinup
- Model outputs: T, S, U, V, SSH …every 3h

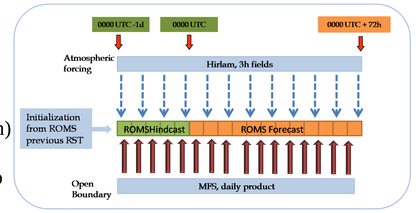
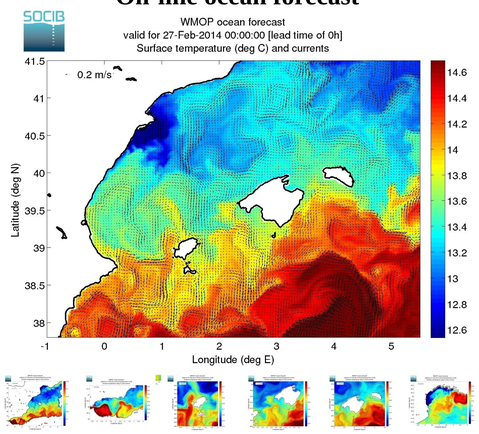


Fig. 2 : The WMOP forecasting system

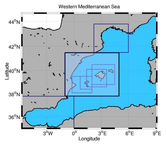
3. WMOP visualization

3-day forecast: 3h, 1.5-2km
High-resolution animations and figures

On-line ocean forecast



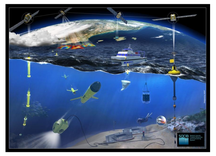
Select a specific region:
Western Mediterranean Sea, Alboran Sea, **Balearic Islands**, Ibiza Channel, Ibiza-Formentera, Mallorca Channel, Mallorca-Menorca, Gulf of Lion.



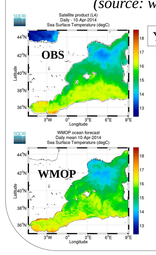
lw4nc application: an interactive system has been developed to visualize the model outputs selecting variables (temperature, salinity, currents, free surface, barotropic velocity) and visualization types (snapshots, animations, maps, time series, regional zooms, sections, fixed positions, etc...).

4. On-line operational validation system

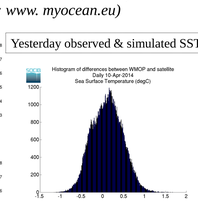
Multi-platform observations with various spatial and temporal resolutions and coverage, from satellite products and *in situ* measurements, are used for the routine model validation. Comparisons model-observations are done using various statistical metrics and diagnostics.



Sea Surface Temperature
Satellite products (1/16º)
(source: www. myocean.eu)



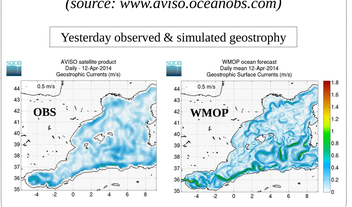
Yesterday observed & simulated SST



Mean(mod-obs): 0.12
Median(mod-obs): 0.11
Std(mod-obs): 0.36

Geostrophic current
Satellite products (1/8º)
(source: www.aviso.oceanobs.com)

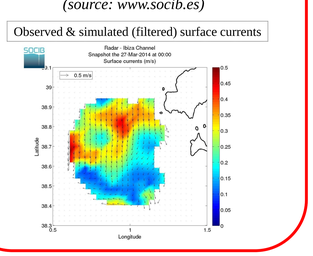
Yesterday observed & simulated geostrophy



- General circulation reproduced in the simulation.
- Highest mesoscale activity in the ocean forecasting system.

Surface currents
HF radar in Ibiza Channel (1h, 6km)
(source: www.socib.es)

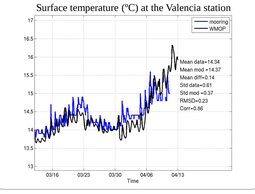
Observed & simulated (filtered) surface currents



!! New technologies providing high resolution data !!

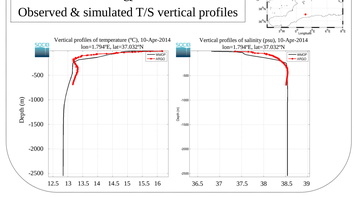
Temperature, Salinity, Currents
Fixed moorings (illustrated Fig.1)
(source: www.socib.es, www.puertos.es, www.meteofrance.com)

Time serie, histogram, scatterplot for every station and variable



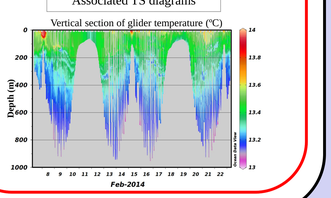
Temperature/Salinity profiles
Argo floats
(source: www.socib.es, www.ifremer.fr)

Position of yesterday Argo profile(s)
&
Observed & simulated T/S vertical profiles



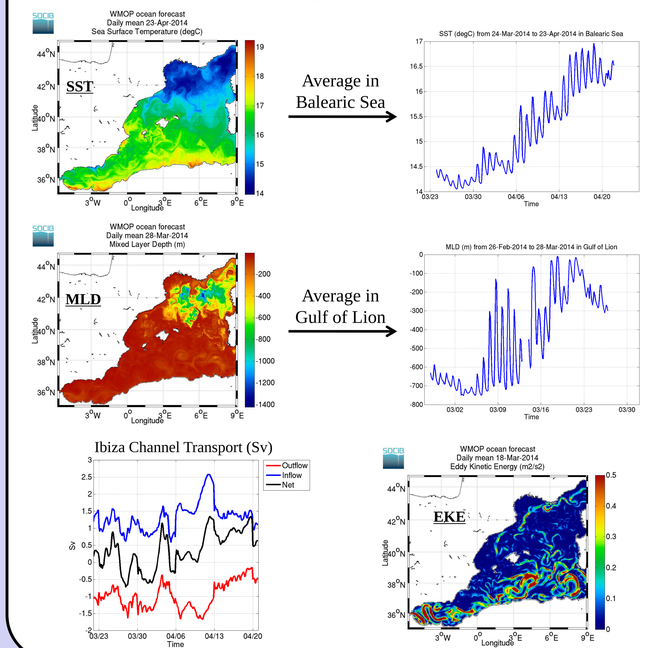
Temperature/Salinity profiles
Gliders in Ibiza Channel every month
(source: www.socib.es)

Observed & simulated
Vertical T & S sections
Associated TS diagrams



5. Long-term oceanic indicators

Long-term indicators (Sea Surface Temperature and Salinity, Eddy Kinetic Energy, Mixed Layer Depth, Heat Content within [0-150m], transports in key sections) are calculated from WMOP over the whole basin and in sub-regions (Alboran Sea, Balearic Sea, Gulf of Lion, see Fig. 1), so as to follow their temporal evolution.



Conclusion and perspectives

- The high-resolution SOCIB WMOP forecasting system is operational, available and evaluated **on-line** at **www.socib.es**.
- **Operational (daily) validation and long-term comparisons** with observations (soon available on the website) have shown the realism of the ocean forecasts.
- **Sensitivity tests** (atmospheric forcings, boundary conditions e.g. Mercator) are being done to improve the WMOP ocean forecasting system.
- The improvement of the forecasting system is also based on **hindcast WMOP simulations** (2009-2013) through an assessment with historical observations and science-based studies ([4]; poster B976, 30th April).
- **Data assimilation**, which is not yet implemented operationally, will also allow to improve the system, combining information from satellite products, *in situ* data (Argo floats) and new high-resolution data (gliders, HF radar).

References

[1] Shchepetkin and McWilliams (2005), The regional oceanic modelling system (ROMS): A split explicit, free surface, topography-following coordinate oceanic model, Ocean Modell., 9, 347–404, doi:10.1016/j.ocemod.2004.08.002.

[2] Smith and Sandwell (1997), Global sea floor topography from satellite altimetry and ship depth soundings, Science, 277, 1956–1962, doi:10.1126/science.277.5334.1956.

[3] Tonani et al. (2012), Operational evaluation of the Mediterranean Monitoring and Forecasting Centre products: implementation and results, Ocean Sci. Discuss., 9, 1813-1851, doi:10.5194/osd-9-1813-2012.

[4] Juza et al. (2013), Origin and pathways of WIW in the North-western Mediterranean Sea using observations and numerical simulations, J. Geophys. Res., 118, 1-13, doi:10.1002/2013JC009231.

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